BULLETIN
GEORGIA ACADEMY OF SCIENCE

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The 1953 Annual Meeting

The 30th Annual Meeting of the Georgia Academy of Science will be held at Mercer University, Macon, on April 24, 25, 1953. Announcements of the meeting have already been sent out and plans are being formulated for one of the best meetings in the history of the academy. A committee composed of the president, the vice president and the secretary visited Mercer on January 16 to discuss and make plans with the local committee at Mercer. In addition to the many attractive features presented by the Mercer campus a barbecue luncheon is being planned for Friday.

The programs for the scientific sessions are being formulated by the chairmen of the respective sections. You should receive a request in a short time—should have received it before this issue of the Bulletin is mailed—for papers to be presented in one of the sections. However, there are some members who have not returned the card sent out with the last issue of the Bulletin and consequently we do not know in which section they belong. (A few were returned unsigned). Also there are several who have interests in more than one section of the Academy. If you are in either of these categories, or if for any other reason you do not receive a notice from the section chairman do not hesitate to request a place on the program if you have something to present. Include an abstract and the other information requested on the general notice and send to the chairman of the section best representing the subject of the paper. The secretary will be glad to lend assistance and give help where

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needed. Until the sections are better organized and more sectional interest is manifest it will be necessary for each member to feel obligated to make some contribution to the program of the Annual Meeting. Eventually we hope the chairmen of the various sections will be 'fighting' for time and space on the program. Arrangements have been made for sufficient space and adequate equipment for a large number of papers at the forthcoming meeting at Macon.

Let us all plan to be at the Macon meeting both to contribute something to the meeting, and to enjoy the scientific presentations and the fellowship.

News Items

Dr. Evangeline Papageorge was chosen Woman of the Year in Education in Atlanta in January 1953. Dr. Papageorge is Associate Professor of Biochemistry in the School of Medicine, Emory University.

A department of Bacteriology has been formed at the University of Georgia for both graduate and undergraduate work. Dr. Martin Frobisher, Jr. formerly of the U. S. Public Health Service, Communicable Disease Center, is chairman of the new department.

Dr. R. B. Platt, Associate Professor of Biology, Emory University, received the George Mercer Award of the Ecological Society of America for "an outstanding paper in the field of ecology, published during the years 1950-51" at the meeting in Ithaca, N. Y.

Dr. Mary S. MacDougall retired from the Department of Biology, Agnes Scott College, in June 1952. She had been chairman of the department for more than 30 years. At present she is living in Decatur and working on a new textbook of biology.

A chapter of the Society of the Sigma Xi was granted to the Georgia Institute of Technology, Atlanta, at the Annual Meeting of the society in December at St. Louis.

The Historian of the Academy, Dr. W. B. Baker, is making progress on a history of the academy to be pub-

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lished in an early issue of the Bulletin. Dr. Baker is finding some interesting data on events which transpired in the Academy during some of its earlier years.

Know of some news item? Send it in to the secretary for the next issue of the Bulletin. Let's tell others what is going on.

Exchanges of the Bulletin of the Georgia Academy of Science

Through an agreement made by the former secretary of the Academy, Dr. A. S. Edwards, with the Gift and Exchange Section of the University of Georgia Libraries the Bulletin of the Georgia Academy of Science has a wide distribution. A list of the libraries to which the Bulletin is sent indicates that 52 university and college libraries, 9 state or municipal libraries and 32 state academies of science in the United States receive it. In addition it is sent to 3 libraries in Canada, 2 in Brazil, and to one each in the following countries: Argentina, Colombia, Cuba, France, Japan, and Mexico. The list of the institutions with addresses was furnished the secretary by Miss Elizabeth Riley of the Gift and Exchange Section.

The publications received in exchange for the Bulletin are being held and catalogued at the University of Georgia Libraries and a list is being prepared for the academy. Both lists will be kept in the permanent files of the secretary and will be available to members at any time.

Boners

(Answers received to questions in the Department of Biology at Emory University):

Oxyhaemoglobin: They come out at Halloween.

Euglena: Something found under the microscope.

Necator: Bees make honey from it.

Kissing bug: A nice thing to have around I should think.

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Kissing bug: Offspring of the love bug, bites the younger generation in the spring.

Kissing bug: Couldn't live without 'em.

Spore: A male egg.

Taenia has a gentile pore on the side of each proglottid.

Bacteria are animal like because they do not stop eating when they have enough.

Titer: A tick which carries organisms which produce relapsing fever.

Annual Dues

The Secretary has just received a long list of members who are behind in payment of dues for two years or more. The by-laws state that any member who is delinquent for two years shall be dropped from the membership. The present officers are hesitant in removing the name of any member from the roll as they realize that some of the delinquency is due to neglect in sending in the dues. Nevertheless, it is costly to the academy to continue to carry persons on the roll who are not interested in being members. Largely because of the untiring efforts of Mr. F. Homer Bell the membership is increasing. More than a hundred new members have been added since the last meeting and applications are still being received.

Due to the size of the state and the wide distribution of the members it is somewhat difficult for the council of the academy to plan a program that will include all members. For the same reason it is difficult for a member in a distant part of the state to serve as officer or council member. In order to do the work necessary for the continuation of the academy it requires some degree of nearness of the officers. Attempts to include members in the council from distant points have invariably worked hardships on the member, or resulted in inattendance at the council meetings.

It is realized that not all members are interested in the work associated with the Junior Academy. The Science Fairs have been a huge success and those who have attended one or

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more can vouch for their value in stimulating interest in science among the high schools of the state. Until last year the Senior Academy was largely responsible for the finances necessary for the fairs in Atlanta. The Senior Academy has had also an important part in the Science Talent Search and has backed this work with both personnel and finances. It is believed that the work of the Junior Academy can now be carried on by the members of that organization with little or no help from the Senior Academy. Accordingly, the president has appointed an Academy Improvement Committee with Dr. Rubin Gotesky as chairman, to study and make suggestions for projects that can be undertaken by the Academy. A preliminary report of Dr. Gotesky's committee is published in this issue of the Bulletin. Some of the projects which have been mentioned and are being studied will require the interest and effort of many members of the Academy. We feel sure that there are problems in the state of Georgia which the Academy can help to solve and in so doing benefit itself as well as others involved. There is enough talent and 'know-how' incorporated in the membership of the Academy to undertake projects and problems in most any field of science. By working together the members of the Academy can make the Georgia Academy of Science one of the best State Academies in the country. We should have a thousand members instead of less than five hundred. It is hoped that each member will not only pay the small amount of the dues but will also help to increase the membership by nominating at least one new member each year. Membership blanks may be obtained from the secretary.

The Microbe is so very small
You cannot make him out at all,
But many sanguine people hope
To see him through a microscope.
His jointed tongue that lies beneath
A hundred curious rows of teeth;
His seven tufted tails with lots
Of lovely pink and purple spots,
On each of which a pattern stands,

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Composed of forty separate bands;
His eyebrows of a tender green;
All these have never yet been seen—
But Scientists, who ought to know,
Assure us that they must be so . . .
Oh! let us never, never doubt
What nobody is sure about.

H. Belloc

THE DEPARTMENT OF ANATOMY OF EMORY UNIVERSITY SCHOOL OF DENTISTRY

JAMES A. MILLER, JR., Ph.D.

STAFF:

The Department of Anatomy of Emory University School of Dentistry consists of the following staff members:

James A. Miller, Jr., Ph.D., Professor; Stephen W. Gray, Ph.D., Associate Professor; Emily B. Walker, A.M., Assistant Professor; Betty F. Edwards, A.M., Instructor; Thomas Conner, Jr., D.D.S., Teaching Assistant (part time); Faith S. Miller, Ph.D., Research Assistant (part time); Dorothy Q. Reeves, A.B., Technician; Caroline J. Nabors, B.S., Secretary (part time).

QUARTERS:

The Department occupies the ground floor of the Basic Science Building, located between the Chemistry and Biology Buildings on the main Emory Campus. The building, completed in 1951, includes in addition to a lecture hall and teaching laboratory the following facilities of the Anatomy Department: three offices, three combination office-research laboratories, two research laboratories, a small animal operating room, a library-conference room, a combination dark room-fluorscopy room, four store rooms, one for general storage, one for alcohol, one for bones, and one on the fourth floor for dead storage, and an air-conditioned small animal room. In addition there is a room and a runway for dogs and large animals shared with Physiology and Biochemistry.

TEACHING:

Two courses are being taught at present, Gross Anatomy and Histology-Embryology. The staff of the Gross Anatomy course consists of Dr. Miller, Mrs. Walker and Dr. Conner. Perhaps the chief feature of the

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course is our use of audio-visual teaching aids. The department has over 1000 Kodachrome 2" x 2" slides and 12,000 feet of 16 mm. Kodachrome dissection films prepared by Drs. Markee and Hollinshead of Duke University. These actually improve on nature since before the camera was started, to Dr. Hollinshead's meticulous dissections were added red coloration on the arteries, blue on the veins, yellow on the nerves and white on the lymphatics. The slides consist of photographs of dissections and of illustrations from textbooks, atlases, research papers and publications such as the Ciba Symposia. Most of them were made in the department with a Leica camera and a sliding focusing outfit. By using a Weston exposure meter set at a film speed of 4, taking readings off of white paper and increasing the exposure according to the table in the Leica Manual, consistently good color was obtained.

Color is so much superior to black and white for anatomical illustrations that we have colored certain unusually excellent illustrations such as the neck dissections in Grant's Atlas and the ear dissections in Spaltehiolz "Hand Atlas" (prewar edition), which were published as half tones. Very satisfactory color slides have resulted using either Mongol indelible pencils or regular water colors. Most atlas figures contain too much detail for good lantern slides. The most satisfactory plates for copying with which we are familiar are the series which have been published from time to time over the signature of Frank Netter, M.D. in Ciba Symposia. They are both anatomically accurate and artistically effective.

Histology-Embryology, formerly taught in another department, has been recently added to the course offerings of the Department. Dr. Gray and Mrs. Edwards instruct in this course. The histology loan collection is being rapidly built up, with human and mammalian tissues. For embryology a magnificent set of serially sectioned pig embryos has been prepared by Mrs. Reeves including both cross and sagittal series, between 10 mm. and 25 mm.

Moving pictures are extensively used in this course also. The Department owns a number of teaching pictures, including two which are especially valuable, the "Development of the Nervous System" by McDonald and a sound Kodachrome film "The Development of the Heart" by Rushmer and Blandau. The past year the Department produced a Kodachrome teaching film of our own, entitled "Histological Technique." It is designed to aid students, who do not have the opportunity to prepare tissues for histological study, in understanding problems in interpreting what they see on a prepared slide. A number of the readers of this journal saw an abbreviated version of the film at the joint meetings of the Georgia Academy and the Association of Southeastern Biologists last April.

This coming year a one semester course in Applied Anatomy of the Head and Neck is to be offered to the Seniors. Offerings in the Graduate School by members of the department are:

Physical Morphology (Dr. Gray)
Fetal Physiology (Dr. Miller)
Anatomy and Physiology of Speech and Hearing (Mrs. Walker)

RESEARCH:

Research activity in the Department is perhaps best indicated by a list of the titles of articles or abstracts by members of the Department which have appeared in print during the past three years.

Titles by Dr. Gray:

1950. Influence of water temperature on time of survival after submersion.

1950. Pattern of contraction and relaxation in tortoise ventricle.

1950. Effect of supranormal gravitational force on swimming habits of tadpoles (with Rebecca Webb).

1951. Respiratory movements of rat during drowning and influence of water temperature upon survival after submersion.

1951. Changes in morphology of wheat coleoptiles subjected to centrifugation (with B. F. Edwards).

Titles by Dr. Miller:

1950. Some effects of adenosinetriphosphate upon survival and spon-

taneous recovery from asphyxia in newborn guinea pigs (with F. S. Miller and C. B. Farrar).

1950. The use of hydrogen peroxide to prolong life and reduce recovery time in asphyxiated neonatal guinea pigs.

1950. Are nutritive substances necessary for hydranth formation in Tubularia?

1951. Effects of temperature on resistance of guinea pigs to anoxia (with F. S. Miller and C. B. Farrar).

1951. A moving picture demonstration of the effects of elevated and reduced temperature upon the resistance of guinea pigs to asphyxia.

1951. "Embryology by L. G. Barth" (book review).

1952. "Histological Technique"—a Kodachrome moving picture.

1952. Some anatomical considerations in mandibular block anesthesia.

1952. Relationship of the notochord to the cartilage of the skull with the location and frequencies of chordomata.

Titles by Mrs. Walker:

1951. Some anatomical evidences of brain injury causing cerebral palsy.

1952. Pathways in a cerebral palsy brain.

The Department would like to take this opportunity to extend to members of the Georgia Academy of Science an invitation to visit our new quarters and appraise our teaching and research facilities.

Fluoridation and Dental Caries

By ROBERT S. INGOLS
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Dr. Williams, a practicing dentist from Atlanta could hardly believe his eyes several years ago when he had the opportunity to examine the mouths of children in Brunswick and Moultrie, Georgia, for he saw so few teeth which were decayed or missing. The water supplies in Brunswick and Moultrie contain 0.7 p.p.m. fluoride ion while Atlanta's water contains none.

That the incidence of dental caries in children and adults is abnormally low if they happen to live in a community whose water supply contains 1 p.p.m. of fluoride ion has now been widely reported in the literature. This fact was first noticed by Dean in 1938. Since that time it has received a great deal of study throughout the country.

Other communities in the state of Georgia are obviously interested in the possibility of obtaining the low caries experience characteristic of Brunswick and Moultrie. Consequently, several have now begun to add fluoride to their water, and such action is up for discussion in many other cities. The purpose of the present paper is not to promote the addition of fluoride to city waters but rather to lay facts before the scientists of this state in order that they may form their own conclusions as to the desirability of fluoridation.

The addition of sodium fluoride to our public water supplies is being advocated by the dentists of the state whose livelihood is largely based on treatment of decayed teeth. It is evident that their motives are ethical, since they are the group that stands to lose the most financially from the results of fluoridation.

Let us examine for a moment the incidence of dental caries in a town where no fluoride is present in the water. The normal expectancy of dental caries in children 16 years of age is 600-700 cavities or missing teeth per hundred children examined. In a town whose water contains approximately 1.4 ppm fluoride, only 250 cavities have been found per 100 children examined. Because of this very large difference in the dental caries experience, it is quite obvious that one should wonder whether one can enjoy better teeth by adding fluoride to the public water. A second question must be considered, will this cause any other problems in the health of the people.

Colorado Springs, Colorado, and Aurora, Illinois have been using water which is now known to contain 2 to 3 p.p.m. of fluoride. It is expected that this condition has been going on for 60 years because the

same wells have been used. An examination of the teeth of the indigenous adults indicates that the number of carious teeth is extremely low. This contrasts with the dental caries experience of people who have always lived in areas where water contains no fluoride, while no difference has been noted in the general health of these people. A study of the bone fracture experience in men drafted from towns with high fluorides was compared with men was Washington, D. C. during the last war. No differences were found in the frequency of the bone fracture.

Beginning in 1945, the city of Grand Rapids, Michigan, began adding 1 to 1½ ppm fluoride to its public water supply. At that time the Public Health Service began an intensive survey of the condition of the teeth of children in that city. This survey is continuing and the dental caries experience in Grand Rapids is being compared with that in Muskegon, Michigan. Both of these cities use water from Lake Michigan but only Grand Rapids will add fluorides to its water. To date the survey shows that children in Grand Rapids have much better teeth than those in Muskegon, Michigan. Similar results have been found in controlled studies in Kingston and Poughkeepsie, N. Y. The results of all experiments and the data from many towns having natural fluorides have both been so favorable that Public Health authorities and the American Dental Association have concluded that the addition of sodium fluoride to public water supplies would be desirable. During the Spring of this year a congressional committee held a long series of hearings in which both proponents and opponents of the fluoridation program were given an opportunity to testify. At the conclusion of this testimony this committee decided that the addition of fluorides to the water for the city of Washington, D. C. was justified. Since September, 1952, Washington has had fluorides added to its water.

Unfortunately, however, the picture is not entirely one sided and some people have stressed the potential dangers of artificial fluoridation. Because the opposition is very vocal, it is desirable that some of the objections be answered.

Some cities in this country have water containing fluorides in excess of 1½ p.p.m. Where the higher concentrations exist some people's teeth have mottled enamel (enamel with a brown stain). Where very much higher concentrations of fluoride exist (that is 8 to 14 p.p.m.), the enamel has become brittle and broken. The possible development of poor or mottled enamel from high fluoride concentrations has made many people fearful that the artificial addition of fluoride to public water will bring on this condition.

Further, some people have been told that fluorides are used as rat poison and that, therefore, the addition of any amount of fluoride to their water is going to be dangerous because it is so toxic. This idea is based upon the fact that the ingestion of possibly 200 to 400 milligrams at one time can cause quite distressing symptoms such as vomiting or diarrhea. There is some objection to the expense involved in adding fluorides to public water supply on the basis that it benefits only children. Also, some of the opponents to this concept of adding fluoride to water claim that they do not have any choice if they care to drink water without the fluoride. They suggest that it be added in the home to water or food. Some opponents feel that there is a difference between natural and artificially added fluorides.

In answer to the opposition, let us first deal with the question of economy. Since no one can tell what portion of the water will serve what use, it would seem sensible to prepare a water that will best suit all needs. This is already done for safety in drinking with chlorine, for its use in washing and laundering by softening and for its appearance and added safety by coagulation and filtration. As regards expense, it should be pointed out that sodium fluoride is a comparatively cheap salt and that sodium silico-fluoride, a by-product in the manufacture of fertil-

izers, is even less expensive than sodium fluoride. Because of the low cost of fluoride the addition of 1.5 p.p.m. sodium fluoride will amount to approximately 10 cents per year per capita, exclusive of the cost of necessary equipment. Surely this amount of money is not too much for the reduction of pain and the cost of treating dental caries. Furthermore, many people cannot afford the cost of filling cavities, so that the only approach to better teeth is the addition of fluoride to the water.

In spite of the comparatively low cost of fluoridation, the addition of more than the optimum amount of fluorides will be uneconomical and water plant operators will guard carefully against the use of any excess. Inadvertent addition is unlikely because equipment, if broken, will fail to add any chemical rather than too much. It may be pointed out that the addition of fluoride to water or to food or other materials in the home or in many small businesses would be a rather hazardous proposition because of the danger of storing fluoride and because of the small amount needed daily.

Natural foods contain only a very small amount of fluoride in relation to their dry weight and, when one considers the total volume of food ingested in a day, the total fluoride which may be derived from food amounts to less than half a milligram daily. Water containing fluoride in concentrations of 1 p.p.m. would supply to an adult approximately 1½ milligrams per day or a total intake, with food, approaching 2 milligrams per day. This amount of fluoride fails to accumulate in the body in any sensible amount in any tissue except the bone and teeth.

It has been assumed so far that the fluoride is present in the water or food as the fluoride ion. While there is a possibility that some carbon-fluoride bond might be formed into an essential molecule in the body, there is no evidence for this belief, since no fluoride organic compound of biological origin is known. The only allied organic compound of human biological origin that is generally known is that of thyroxin which contains an iodine-to-carbon bond in a benzene ring. Although the chlorine ion is present in human blood in very much larger concentrations than the iodide ion, there is no evidence of the ability of the human body to synthesize the smaller chlorine ion into an organic bond. Since the fluoride ion is even smaller than the chloride ion, it seems highly unlikely that the body can synthesize it into an organic compound. It also seems virtually impossible from an energy relationship viewpoint to form the carbon-fluoride bond by biological agencies. This means that the naturally occurring fluorides must be in ionic form in order to be useful to the human body. This is also true of the fluoride that is ingested with the food, even though it may appear to be a part of the organic material.

This brief review has attempted to present facts concerning fluoridation and dental caries in order that scientists in Georgia may better understand why dentists and public health workers are promoting this means of reducing the pain and economic loss of poor teeth.

The Geology Field Camp of Emory University

By J. G. LESTER

The solution of problems in modern geology, one of the younger sciences, is no longer a question of reconnassaince on horseback over unmapped trails or the slower progress on foot in virgin territory, but rather a combination of detailed work in the field combined with more detail work in the laboratory through the media of modern laboratory equipment. It is, therefore, essential that a department of geology, in order to do high caliber work, should have available for the use of its students and staff resources sufficiently large to accommodate both field and laboratory investigations.

The Department of Geology at Emory University considers itself fortunate indeed in having a building large enough to house adequately, laboratories in mineralology, petrol-

ogy, sedimentology, economic geology and paleontology. The equipment for these laboratories is excellent and adequate for undergraduate and limited graduate training, but additional specialized equipment should be acquired before graduate work in geology can be expanded to any great extent beyond the master's level.

On the Emory University campus the Geology Department owns and operates four vehicles which are used for undergraduate and graduate field trips; for graduate field research; for individual investigations of staff members and general departmental field work. In addition to these vehicles the University makes available busses for field trips in the larger beginning classes.

During the summer quarter the Geology Department adds to its offerings two field courses. One of these carries 7½ quarter hours credit and lasts for five weeks; the other carries 15 quarter hours credit and lasts for 10 weeks. Both of these courses are conducted at the Geology Field Camp about eight miles west of Ringgold, Georgia in Catoosa County and some ten or twelve miles south of Lookout Mountain, Tennessee.

The Camp is located on thirty acres of rolling valley land and comprises a laboratory building; two dormitory buildings, with a capacity of 40 students; and a main lodge in which are housed the kitchen and dining hall, library, lounge, and living quarters for the instructional staff. A small lake, volley ball court, badminton court, horseshoe court and table tennis supply recreational facilities.

The Camp is ideally located for work in mapping procedure because of the great number of benchmarks previously established by governmental agencies and because of the excellent topographic maps of the area prepared by the Tennessee Valley Authority. The student is given instruction in Plane Table mapping as applied to geological work; the use of the Brunton Pocket Transit in rough mapping and in measuring structural details; in altimetric recordings; and in the interpretation of aerial photographs. Upon completing the course the student should be able to use the usual field instruments of the geologist with speed and accuracy.

Work in stratigraphy, structure and invertebrate paleontology is made interesting because of the occurrence of 26 different stratigraphic units ranging from the Cambrian to the Pennsylvanian. Minor structural features occurring within the separate units aid materially in the overall understanding of the major structures of the Appalachian province.

Each graduate student is assigned an individual problem which includes an area to be mapped carefully enough to show all mappable units, structural controls and lithology. Fossils, rocks, and minerals are collected, identified and located in their proper stratigraphic positions; the physiography is studied and its evolution explained. All of this work is brought together as a coherent unit in a written field report which must be illustrated with photographs, geologic columns, charts, photomicrographs, and a geologic map.

Two to three lectures per week are given at night by the instructors and occasional lectures by visiting scientists from other fields are held. Quizzes and examinations are required as in any regular course.

The instructional staff is on duty from 8:00 A.M. to 11:00 P.M. for discussion of general and individual problems, for advice and guidance. No classes are held on Saturdays and Sundays.

In addition to the students regularly enrolled in the Field Course, graduate students from Emory and other institutions, whose thesis problem is in the general vicinity of the camp site, may use the Camp as a base of operations for field work. It is hoped that these field facilities will be of greater use to graduate students in geology from Emory and other neighboring institutions. The area offers excellent opportunities for graduate work in field zoology, field botany and geography, and students and faculty members interested in these fields will be encouraged to use the Camp for their field work.

Report of the Activities of the Academy Improvement Committee

On September 9, 1952, Dr. A. L. Cohen, President of the Georgia Academy of Science, wrote Dr. Rubin Gotesky, University of Georgia, inviting him to serve as chairman of a new committee, the Academy Improvement Committee. Its purpose, as defined by the President, is to develop a long-range program, pliant and resilient enough, to guide the Academy in its planning for some period of time. The function of the Committee is purely advisory. After acceptance on October 2, 1952, Dr. Gotesky formed a committee composed of the members named below:

Baker, W.B., (Biology), Emory University; Calder, W. A., (Physics), Agnes Scott College; Chambliss, Rollin, (Sociology), University of Georgia; Furcron, A. S., (Geology), State Department; Jost, Hudson, (Psychology), University of Georgia; Hart, J. F., (Geology), University of Georgia; LaRocca, J. P., (Pharmacy), University of Georgia; Levit, R. J. (Mathematics), University of Georgia; Scott, A.W., (Chemistry), University of Georgia; Westfall, J. J., (Botany), University of Georgia.

A report on the formation of the committee was made to the Executive Council at its meeting at Emory University in December, 1952. During the Christmas holidays, an informal meeting was held by the chairman with Drs. Chambliss, Scott, and Westfall, to discuss the agenda he had prepared for the full meeting of the Committee. At the informal meeting, it was recommended that the chairman send a letter to the Presidents of four State Academies of Science, requesting information about their efforts to encourage and develop the science resources of their states. Some time later, Dr. Furcron generously offered to mimeograph the letter and send it to all other Academies of Science in the United States. The letter sent to these Academies, with the help of Dr. Furcron, is appended below:

Dear Mr. President:

At the request of the Academy Improvement Committee, Georgia Academy of Science, I am writing to obtain as full information as you can conveniently send me concerning the efforts made by your Academy to improve the status of science in your state. In particular, our committee would like to know not merely what you have done but the extent and causes of your success or failure. Our committee is presently engaged in developing a long-term policy for the Georgia Academy of Science; and it is our desire to take as much advantage of the results of your experience, both good and bad, as possible in promoting the growth and spread of science in the State of Georgia.

Perhaps the following questions may help to guide you in providing us with essential information for our inquiry:

1. What has your Academy done in the way of improving and encouraging research, both quantitatively?
   - a. By using awards and recognitions?
     - i. Have awards and recognitions been given to individuals or to groups and institutions or both?
     - ii. What criteria have been used in making proper judgments?
     - iii. What kinds of awards and recognitions have been used? How effective have they been?
   - b. In obtaining funds or establishing funds for research?
     - i. Have permanent boards of trustees been established for administering or awarding grants? Or have recommendations been the procedure? Have any other devices been used?
     - ii. How successful have your methods been?
   - c. In establishing permanent liaisons between the Academy and other institutions (learned, professional, or other) for encouraging and guiding research?
2. What has your Academy done

to improve the instruction and understanding of science?

a. In the elementary and high schools?
b. In co-operation with other groups and associations, (professional, parent-teacher, or other) in developing sound curricula and good teaching?
   i. Have you established permanent committees for such purposes? Have they been co-ordinated in any way with the schools of education in your state?
   ii. Have you established legislative committees, working with similar committees of other professional organizations to advise your state legislature on appropriations for education and research?
   iii. Have you established working relations with your state board of education for the above purpose?

3. What policies and practices does your Academy follow with respect to publications?

a. A general periodical.
b. Proceedings of conferences or conventions.
c. Larger research results: supplements, brochures, monographs, etc.
d. Financing one or all of a, b, and c.

I know that these questions impose a large task upon your limited time, but if you are not able to provide our committee with information upon all these matters, let me assure you that our committee will be grateful for such information as you can make available to us.

Very sincerely yours,
Rubin Gotesky, Chairman
Academy Improvement Committee
Georgia Academy of Science

On January 16, 1953, the full committee officially met at Meigs Hall, University of Georgia, and approved the following recommendations for consideration by the Executive Committee of the Academy:

1. That a permanent liaison committee be created for the purpose of co-operating with all state and private agencies — state and local boards of education, colleges of education, etc., — interested in the development and improvement of science curricula and science teaching in the public schools and colleges of the state. To achieve this objective, it is suggested that the liaison committee approach the most important of such agencies to determine in what ways the Academy can co-operate with them in the formulation of policy, standards, etc. On the basis of such information, the committee is to organize itself for maximum efficiency and usefulness.
2. That the council members, heading the various divisions, with the aid of three members of the division, be requested to write a yearly report on Scientific Progress in Georgia in the fields of interest in the division for publication in a special issue of the Bulletin. These reports shall contain information regarding research completed and in progress; the names of individuals and institutions engaged in such research; titles of papers published by members during that year; grants made; and any other information which may be of interest to the membership in general.
3. That the Academy establish a clearing house for information concerning research opportunities and grants in all areas of science; the purpose of the clearing house is to make available, at relevant intervals, either by publication in the Bulletin or as a mimeographed report, such information to the Academy membership.
4. That the Bulletin limit itself to articles of general rather than specialized scientific interest; also that each issue con-

tain such items as necrology, research, grants, recently made to members; promotions, resignations, etc.

Concerning other issues brought to the attention of the committee—such as awards, recognitions, publication of monographs and proceedings—agreement on specific recommendations was not achieved.

For the Committee,
Rubin Gotesky, Chairman
Academy Improvement
Committee
Georgia Academy of Science

Meeting of Executive Council

The Executive Council met on December 12, 1952 with eleven of the fifteen members present. Candidates for the offices to be filled were nominated. They were as follows: for president, F. Homer Bell and H. T. Coggins; for vice president, A. S. Furcron and W. A. Calder; for council member to replace J. G. Lester, retiring, W. J. Frierson and Lane Mitchell.

Several committees which the president had appointed since the annual meeting were announced. Some of these committees had already begun to function.

The volumes of the Bulletin were established to correspond with the calendar year, one volume per year. The terms of the officers were established to run from the termination of one annual meeting through the annual meeting of the next year. The council agreed without a motion that should the president leave the state (as resident) the vice president should assume the duties of president, and should both the president and vice president be unable to function it would be the duty of the secretary to call a meeting of the executive council and the council should appoint a chairman Pro Tem to serve until the next annual meeting.

The Executive Committee consisting of the officers and three council members elected by the council was set up. The three council members elected were Mrs. Gordon Brown, Dr. MacDougall, and Dr. Furcron.

The problem of representation of the Junior Academy on the Academy council was discussed. Mr. Eugene Sanders was present at the meeting at the invitation of the president to represent the Junior Academy. The discussion ended without arriving at any solution to the problem.

Tentative plans were made for the annual meeting at Macon, these plans to be subsequently studied and perfected by a group of the officers who could arrange to go to Macon at a later date to meet with a local committee at Mercer University.

MINERAL REQUIREMENTS OF SOME MYXOMCYCETES WITH POSSIBLE BEARING ON THEIR ECOLOGY[1]

Arthur L. Cohen[2] and
Johanna Sobels[3]

In introducing our preliminary studies on this problem it should be stated that the myxomycetes may be divided into a homogeneous calcareous group and a heterogeneous non-calcareous group. The Calcareae, after the ameboid plasmodial vegetative stage is passed, form small fructifications in which calcium carbonate is deposited either in the peridium or outer covering, or in the network of threads and tubes, the capillitium, running between the spore mass inside the fruit or in both. For a long time it was believed that this represented excess calcium picked up by the plasmodium and deposited as waste in these locations. The present experiments, besides showing some other remarkable properties of the myxomycetes, indicate that this calcium may not be considered as excess.

The problem had its inception during the studies of one of us (Cohen) at Harvard University, some twelve years ago on the nutrition of the myxomcetes.[4] In an attempt to puri-

1. Supported in part by a grant from the American Cancer Society on recommendation of the Committee on Growth.
2. Professor of Biology, Oglethorpe University, Oglethorpe University, Georgia.
3. On leave, University of Utrecht, American University Women's Travelling Fellow and Fulbright Fellow. Present address, University of Utrecht, Utrecht, Holland.
4. Cohen, A. L. Bot Gaz. 101: 244. 1939

ty the agar substrate, Difco Bacto Agar was thoroughly washed with tap, then distilled water. Plasmodia grown in pure culture on autoclaved yeast on this washed agar grew poorly, and usually died by the third transfer. It was noted, however, that occasional contaminated cultures on washed agar maintained their vigor equally as well as the pure cultures grown on unwashed Difco agar as a substrate. It was suspected that minerals present in the unwashed agar were necessary for continued pure culture. Experiments in which the mineral content was reconstituted by adding the ash of unwashed agar to the washed agar showed this indeed to be the case. However, the fact that contaminated cultures grew well, that yeast extract alone provides sufficient minerals as well as organic material for the abundant growth of a great number of fungi and bacteria, indicated that it was not so much a question of total quantity of minerals as their concentration; contaminated cultures grew because the contaminants accumulated the minerals from the substrate and in turn served as food for the myxomycetes.

On a return to the culture of myxomycetes over a year ago, Cohen found some difficulty in growing plasmodia in two-membered culture on living yeast streaked on buffered tapwater agar as previously described.[4] The difficulty was laid to loss of skill in techniques after a lapse of some ten years or to change in the strain of yeast. However, when the authors joined in this endeavor, Sobels reported the same difficulty. A constant factor in our previous successful work at Pasadena, California, Cambridge, Massachusetts, Paris, France and Delft, Holland appeared to be hard water—and Atlanta water is extremely soft.

Vigor of cultures was restored when water from a limestone spring was used instead of tapwater in making up the agar. An artificial hard water made of a saturated solution of magnesium and calcium carbonates was also found to be effective. Our present routine culture substrate consists of two percent Difco agar with a mineral medium consisting of two parts saturated magnesium and calcium carbonates, three parts distilled water, buffered at pH 6.0 with potassium-sodium phosphate buffers. This is used as a substrate for continued pure cultures on either autoclaved yeast (Cohen)[4] or a non-partidulate alcoholic yeast extract (Sobels)[5] or two-membered cultures with living yeast. It has been found that either calcium carbonate alone, or with magnesium carbonate serve to maintain growth; the indications being that magnesium alone is perhaps inferior to either the calcium or the calcium-magnesium mixture.

It should be mentioned that attempts to supply a complete mineral medium by the use of either Knop's solution or dilute sea water met with indifferent success. Sea water in a concentration of twenty percent or greater was toxic, in lower concentration it was not the equal of the calcium or magnesium carbonates or a mixture, while Knop's solution in the optimal concentration was not more than the equal of these mineral bases.

A completely satisfactory routine method of measuring growth of plasmodia is lacking. The increase in area of the fan was used, and the rate of creeping over the substrate is a good measure of vigor. A starving plasmodium, or one under unfavorable conditions does not ingest a particulate medium rapidly, moves slowly and shows an irregular fan, or may even round up into irregular droplets. For this reason only gross and obvious differences in growth are mentioned here.

The organic substrates supplied are autoclaved baker's yeast and the alcoholic extract of the yeast. In this laboratory the autoclaved baker's yeast uniformly gave a more rapid and vigorous growth in pure culture than did the alcoholic yeast extract, although the latter has been found to be a good source in the past.[5] The plasmodia employed were two strains of *Badhamia utricularis* and a strain

5. Sobels, J. C. Nutrition de quelques myxomycetes en cultures pures et asociees et leurs proprietes antibiotiques. Gouda, 1950 (thesis).

of *Fuligo septica*. Since many cultures of the latter were found to be contaminated, we are confining our conclusions to the *Badhamia*.

On such organic substrates it is difficult to determine the requirements for other minerals since many such as phosphorous may be presumed to be present in abundance. Thus, substitution of acetate buffers for phosphate did not materially affect growth as far as we could determine. However, we did see indications that the substitution of sodium for the potassium monophosphate in the Sorensen mixtures affected growth adversely. We could detect no appreciable difference between the sodium and potassium phosphate buffer and one made up with potassium phosphates only. The data are not complete enough to permit a decision as to whether it is potassium which is necessary *per se* in appreciable concentration, or whether the chief action is an ion antagonism between sodium and potassium.

Of chief interest is the seeming inability of the plasmodia to concentrate the divalent ions of calcium or magnesium. Hence, these ions must be supplied in high concentration in pure culture, while in two-membered cultures the need is sometimes met by the ability of the associated microorganism on which the myxomycete feeds to concentrate the ions.

One of us (Cohen) has noticed that in the hard water region of the West Coast, the calcareous forms are extremely abundant, especially those which pass the vegetative existence and fruit on the litter of the forest floor, such as leaves, fallen branches, etc. On the other hand the often spectacular wood-inhabiting forms, living within and fruiting on larger branches and the trunks of trees, are rather infrequent. These include the well-known genera *Arcyria*, *Trichia*, *Stemonitis*. The relative abundance appears to be reversed in the soft water and somewhat acid soil region of Atlanta. In the dense hardwood or mixed forests of the hills of eastern Vermont and of North Georgia (Dahlonega, Fort Mountain) with acid soil, log-inhabiting non-calcareous myxomycetes are conspicuously abundant, while the calcareous ones are rare. Brief and sketchy excursions into the limestone regions of Florida indicate that the calcareous forms are relatively abundant in these regions.

A review of the scanty literature on ecological relationships shows some attempt to correlate variety of forms with highly localize conditions[6] with pH and type of wood used as substrate,[7] and with the physical characteristics of the substrate.[8] However, as far as we are aware no previous attempt has been made to study the relations between the abundance of a group of myxomycetes and the availability of certain minerals.

An exception should be made for the ubiquitous and common *Fuligo septica*, which in our experience as well as that of others may be found fruiting on desert sand, in the cracks of a paved sidewalk, six feet up the trunk of living trees, and in other most unlikely habitats, such as the skull of a whale![9]

Should these observations be borne out by further field experience and laboratory experiments, we must revise the commonly accepted idea that the calcareous myxomycetes are forms which accumulate an excess of calcium which may only be gotten rid of by deposition in the supporting structures of the fruits.

The authors hope that these preliminary observations presented here will stimulate interest in field observations and lead to some understanding of the physiological ecology of these fascinating organisms.

6. Hagelstein, R. Mycologia. 28: 547. 1936.
7. Emoto, Y. Jap. J. Bot. 9: 253, 1938.
characteristics of the substrate.[8]
8. Pratt, R. Torreya 34: 37. 1934.
9. Lister, A. A monograph of the Mycetozoa. 3rd Ed. London, 1925 (p. 68).

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